

Claims 1 – 6 are pending. New claims 7 - 13 are added.

The Examiner has rejected claim 6 under 35 USC 112 paragraph II. The Examiner states the stabilization of the terminal groups from claim 6 does not have antecedent bases in the specification.

The applicant provides support for claim 6 on page 17, second paragraph, and lines 10 to 19. Specifically, the specification supports claim 6 by specifying both the process to create stabilized terminal groups and the resulting stabilized terminal group chemical characteristics. The following excerpt from the specification provides the support for claim 6:

“The fluoro-resin in which terminal groups are stabilized is one that the fluoro-resin obtained by polymerization is subjected to fluorination treatment of terminal groups with a fluorinating agent, and specifically, there can be mentioned at least one kind selected from a tetrafluoroethylene-hexafluoropropylene copolymer (FEP), a tetrafluoroethylene-fluoroalkylvinyl ether copolymer (PFA), a tetrafluoroethylene-ethylene copolymer (ETFE), and a tetrafluoroethylene-hexafluoropropylene-vinylidene Fluoride terpolymer (THV).”

Additionally, further support in the specification as filed is as follows:

“It has been found in another embodiment of the invention that where conductivity is imparted by blending carbon nanotubes with a fluoro-resin in which terminal groups are stabilized, such a composition exhibits excellent properties in the points of electric conductivity and static charging characteristics with small blending amount, without deterioration of the physical properties.

The fluoro-resin in which terminal groups are stabilized, that can be used in the production of the fluoro-resin composition according to another

embodiment of the invention, is a resin in which the terminal groups have been subjected to fluorination treatment using a fluorinating agent after polymerization? Specifically, there can be mentioned at least one kind selected from a tetrafluoroethylene-hexafluoropropylene copolymer (FEP), a tetrafluoroethylene-fluoroalkylvinyl ether copolymer (PFA), a tetrafluoroethylene-ethylene copolymer (ETFE), a tetrafluoroethylene-hexafluoropropylene-vinylidene fluoride terpolymer (THV), a polytetrafluoroethylene (PTFE), a polyvinylidene fluoride (PVdF), and a polychlorotrifluoroethylene (PCTFE)."

The Examiner states the prior art is silent as to the stabilization of terminal groups of the fluoro-resin. The applicants' claims to the chemical stabilization of the fluoro-resin terminal groups (polymer ends) are strengthened by the suggestion that the prior art is silent (does not anticipate) to the teaching of stabilized terminal groups.

The Examiner rejects claims 1 and 2 based on 35 USC 102 b. The Examiner states claims 1 and 2 are anticipated by Miyagawa (JP 2003192914A). Miyagawa teaches the composition of Tetrafluoroethylene-hexafluoropropylene comprising the blend with carbon nanotubes.

For Miyagawa to anticipate claims 1 and 2 of the applicant's invention, the prior art must disclose every element of each claim. Claims 1 and 2 are included below for convenience.

"A fluoro-resin composition, characterized by comprising a fluoro-resin in which terminal groups are stabilized, and carbon nanotubes."

"The fluoro-resin composition as claimed in claim 1, characterized in that the fluoro-resin in which terminal groups are stabilized is selected from a perfluoroalkoxyalkane polymer, or a perfluoroethylene propylene copolymer."

The Miyagawa reference does not anticipate claim 1 and 2. The excerpts from the application above, specifying terminal stabilization of the fluoro-resin, are the reason for the unexpected improved processing and material properties of the blends.

Two of the points of novelty not disclosed by Miyagawa are:

1. Fluoro-resin combined with the carbon nanotubes have stabilized terminal groups.
2. The fluoro-resins, with stabilized terminal groups, are blended with carbon nanotubes to form the composition. As supported in the specification the fluoro-resins used in the total composition are selected from the group consisting of perfluoroalkoxyalkane polymer, and a perfluoroethylene propylene copolymer.

The Miyagawa reference, as stated by the Examiner, discloses only the chemical composition of fluoro-resin blended with carbon nanotube without disclosing the feature of stabilization of the ends of those fluoro-resin materials. Accordingly, the Miyagawa reference does not disclose the specific fluoro-resin composition combined with carbon nanotubes to make up the applicants invention.

Miyagawa excludes the composition derived from stabilizing the terminal groups of the fluoro-resin. Therefore, the Miyagawa reference does not anticipate the claims 1 and 2 of the application.

The Examiner rejects claims 3 under 35 USC 103a as being unpatentable over Miyagawa in view of Nishikawa. The Examiner states that Miyagawa is silent to the treatment of carbon nanotube with Fluorine based surfactant. The Examiner looks to the Nishikawa reference to teach the use of the fluorine-based surfactant to treat carbon-based fillers to disperse the fillers in a fluoro-resin matrix.

The applicant transgresses the Examiner's rejections. Specifically, both references exclude the details of the composition found in the application.

Neither alone nor in combination do Miyagawa and Nishikawa disclose each and every element of the claim. Excluded are the details of coating both the carbon nanotubes and the fluororesin. Also, lacking from the Nishikawa reference is the increase in affinity gained when carbon nanotubes are treated prior to being combined with the resin. The improved affinity is accomplished by the applicant's invention. The Examiner is directed to the excerpt from the application below . It details the support for the claim of affinity.

“In the fluororesin composition using the carbon nanotubes as a conductive filler according to another embodiment of the invention, it has been found that because the carbon nanotubes are previously treated with a fluorine-based surfactant, affinity with the fluororesin used increases, and as a result, a fluororesin composition having large conductivity with a blending amount of the carbon nanotubes in smaller amount, and having no falling off of the filler, and having good process ability and mechanical properties is provided.”

The physical behavior of carbon filler treated with surfactant (typically particles with a diameter on the order of microns) does not disclose the same characteristic of carbon nanotubes coated with surfactant. Primarily there is a size scale and a structural difference between carbon nanotubes and standard filler in contact with surfactant. Therefore, carbon nanotubes are not a species of carbon based graphite filler (genus). It is known by those skilled in the art that molecules and nanomaterials conduct electricity and heat by different mechanisms than bulk materials (standard carbon black and graphite filler). As a result one may not combine the references to achieve a success in order to make an obviousness rejection.

By depending from claim 1, claim 3 is narrowed by including all the other composition features . This creates a narrow composition that is non-obvious in view of Miyagawa combined with Nishikawa.

Claims 4-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Miyagawa (JP 2003/1921A) in view of Nishikawa et al. (JP 2000I281855A), Barraza et al. (WO 20041001107), and Khan et al. (U.S. 4,469,846).

The Examiner combines references above to reject claims 4-6 directed to the fluorine based surfactant to disperse the carbon nanotubes. The Examiner maintains that in a water environment of the emulsion polymerization of the fluoro-resin the surfactant used for the polymerization also acts to disperse the carbon nanotubes in the fluoro-resin.

The applicant combined nanotubes treated with surfactant in an extruder. This means that solid carbon nanotubes are mixed with solid fluoro-resin with the extruder set at a specified melting temperature of the fluoro-resin. This solid state to melt mixing of the components take place in the screw of the extruder. The molten mixture of carbon nanotubes and fluoro-resin emerge from the extruder as a molten mixture. Water is the used to cool the polymer mixture yielding a melt processable composite that can be molded into an article with the superior electrical and thermal properties supported by actual reduction to practice.

The Barraza et al., Noda et al., and Khan et al. references use the surfactant as part of an emulsion polymerization to synthesize the fluoro-resin. The surfactant is typically washed away following the reaction unless the material is to be used as a latex coating. Total removal of the surfactant from the fluoro-resin is difficult. According to Raymond B. Seymour and Charles E. Carraher, Jr. (Polymer Chemistry, table 9.7 page 295 third edition published by Marcel Dekker, New York), removal of surfactant and other chemicals used during the polymerization is difficult. One skilled in the art would appreciate the properties of the final polymer would be adversely affected. Ionic substances left in the polymer typically lower the dielectric strength.

Noda et al, is concerned with the stabilization of molecular weight of the tetrafluoroethylene/hexafluoropropylene copolymer, and does not disclose the stabilization of the terminal groups of the fluororesin as claimed in this application.

Nishikawa et al. patent described a carbon-based electrically conductive filler such as carbon black, graphite etc., which are surface-treated with a fluorine-containing compound, as mentioned by the Examiner. However, the fillers such as carbon black and graphite have drawbacks as described in the background art of the present invention, and this is not carbon nanotubes we use.

Barraza et al. patent teaches a preparing method of a carbon nanotube-filled composite, however, in preparing the composite the surfactants used is aqueous surfactant, and not the specific fluorine surfactants disclosed in the present invention.

Kahn et al. patent only teaches core/shell fluoropolymer composition, and there is no disclosure and suggestion of the use of the fluororesin having stable terminal groups and the carbon nanotubes surface-treated with specific fluorine surfactants disclosed in the present invention.

The Barraza reference and Khan et al. performs the emulsion polymerization of the carbon nanotubes in the presence of styrene monomer. The resulting carbon nanotube is surrounded by strands of polystyrene polymer. The literature on carbon nanotubes state this is a mechanism to prevent the London forces from adhering of one carbon tube to another (work first performed by Zyvex corp. and Michigan Tech.)

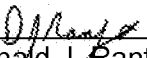
Additionally, the applicant combines carbon nanotubes in the melt, not in an aqueous emulsion polymerization taught in the above references (see explanation above concerning mixing in an extruder). Therefore, the composition is not the same as the melt processed composition claimed by the applicant. The composition of the emulsion processed composition will include chemicals not found in the applicant's composition.

The composition disclosed by the prior art referenced is not the same as the applicant's invention because the carbon nanotubes include styrene and polystyrene. Ultimately the reference above cannot be combined with the others to result in a combination that discloses every element of the claims 4-6 to render the claims obvious.

Neither alone nor in combination, does the prior art cited disclose what is claimed by this invention.

Applicant believes that application is now in condition for allowance and timely allowance is respectfully requested.

Respectfully submitted
for Applicant,

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